

It is surprising that so little has been done in the way of direct experiment upon living fishes, along the line indicated by Dr. Cox's three tests. I find, however, that some years ago an English chemist confined some small cyprinoids in a vessel of water, polluted by the tarry and acid waste poured into the Dee in Cheshire, by petroleum works and carbolic acid factories. On account of the presence of pieric and carbolic acids, the water was yellowish, and it was found that in one gallon of the water there was no less than $7\frac{1}{2}$ oz. of tarry substances. It was found necessary in the experiment to add a quantity (100 per cent) of fresh water, or the fish experimented upon would have died at once. That the water was highly poisonous to fish was proved by its action, even when diluted with an equal volume of tap water. A minnow placed in it made violent efforts to escape, but became still and floated on its side in a few minutes, and in twenty minutes was quite dead. Actual tests and experiments of this kind are urgently needed, in order that prevalent opinions respecting various kinds of pollution may be either confirmed beyond cavil or disproved.

Perhaps the most widespread, and to the general public the most apparent cause of river-pollution is that due to sewage. Cities have from time immemorial regarded rivers as the appropriate channels for conveying away those offensive kinds of waste matters incident to the congregating of large communities. In what precise way sewage affects fish has never been accurately determined; but its injurious effect is a matter of universal opinion. Thus the Canadian fishermen of the Detroit River five or six years ago complained of the amount of sewage poured into that river by the city of Detroit. This sewage and offensive garbage not only polluted the water: but was deposited, when west and south winds prevailed, upon the Ontario shore. 'Since this garbage has been coming ashore' said the fishermen, 'the catch of fish in our nets has been materially diminishing and, if the same continues, the business will be ruined. The presence of the said garbage drives away the fish and renders our fishing privileges useless.' It is not claimed that the fish were actually poisoned and killed: but that they were driven away to other localities. Some authorities who attribute to the sense of smell the action of fishes in forsaking sewage-polluted water, take the above view, and regard sewage as a deterrent more than a direct poisonous agent. This no doubt was the view of Mr. J. A. Harvie-Brown of Dunipace, Scotland, in regard to the Carron when he stated to the Scottish Fishery Board that salmon and migratory trout will not face pollution. The secretary of the Fisheries Improvement Association of Scotland in 1885 said of the Firth of Forth:—

'To recover a stream from a condition of barrenness and resuscitate its fish-bearing powers may be a work of difficulty and of time; but, in the present instance, there is no reason why it should not be hoped, nay, expected, that the trout and the salmon will (after the improvements proposed are effected) at no distant period begin again to tenant the Water of Leith. The Firth of Forth is frequented by many migratory fish of the salmon kind. Dr. Parnell, in his *Fishes of the Firth of Forth*, mentions not only the salmon and the sea-trout, but some eight varieties of Bull-trout. The sense of smell is believed by scientists to be highly developed in the salmon family, and whilst quick to detect the poisonous effects of pollution, and to be driven away, they are not slow also to detect symptoms of abatement, and to return. It is known that this fish runs gauntlets in the form of filthy waters in a manner truly astonishing. 'Almost every year,' says Dr. Gunther, "salmon and sea-trout in the grilse state make their appearance at the mouth of the Thames" (where the migratory salmonoids have been extinct for many years) ready to "reascend and restock this river as soon as its poisoned water shall be sufficiently "purified to allow them a passage".'

On the west coast of Scotland a similar state of things has been described on the Clyde and smaller streams such as the Cart, etc. Of the last named river one writer says:—

'In 1819, the Cart was a pure unpolluted stream throughout its whole course, from the upper part of Eaglesham, where it has its source, to its junction, at Blythwood, with the Clyde. It abounded in fish, and was, in its upper parts above Paisley, a fine trouting stream. A century further back the river was famous for fish of the